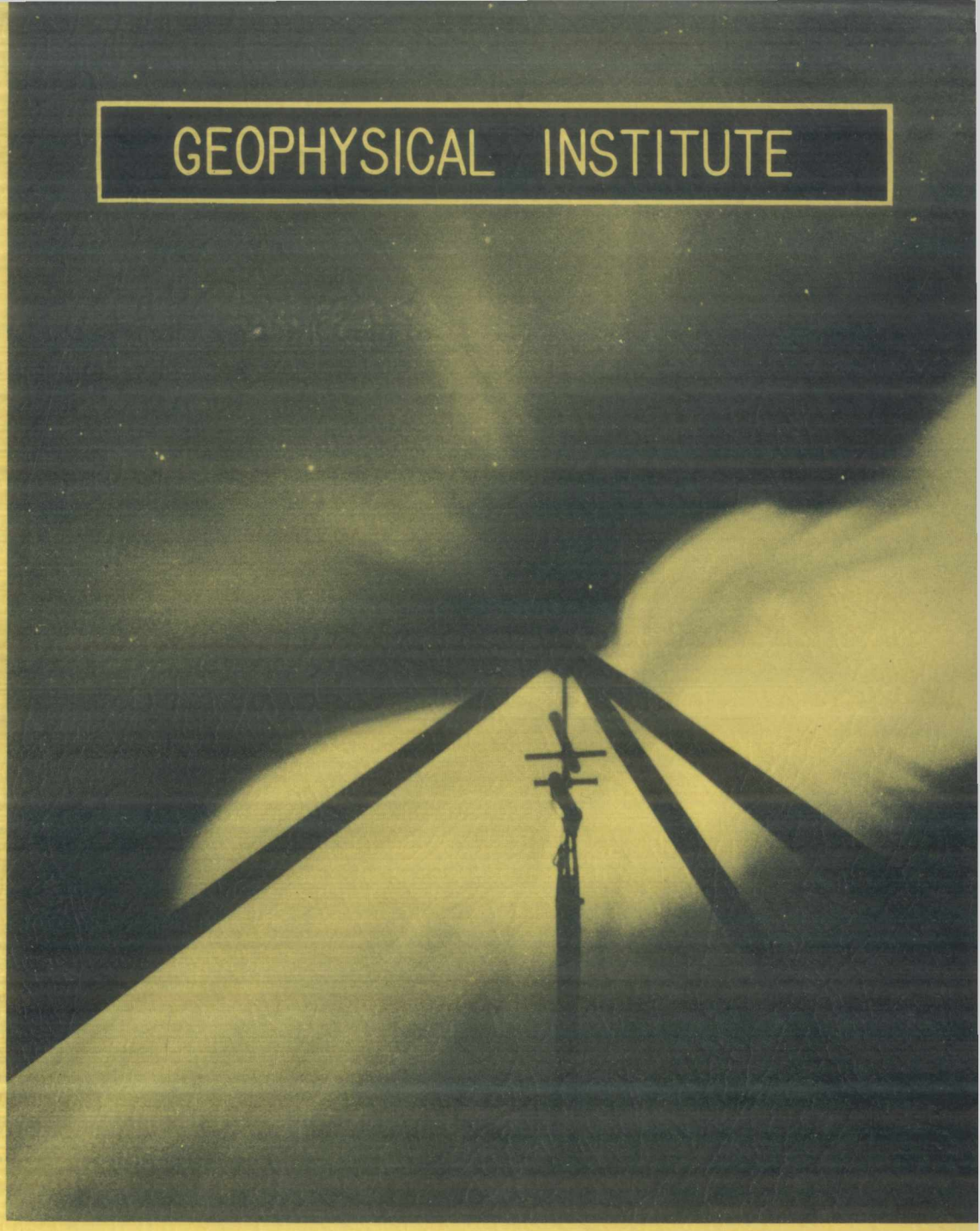

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CATALOGUE OF HUET AURORAL SPECTRA 1957-1959

by

Gerald J. Romick

Scientific Report No. 1
Navy Contract Nonr-1289(00)
March 1961

GEOPHYSICAL INSTITUTE

of the

UNIVERSITY OF ALASKA

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Principal Investigator

C. T. Elvey
Director

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ABSTRACT

The zenith auroral spectra at College, Alaska, obtained during the 1957-1959 observing seasons, has been assembled in catalogue form. The prime purpose of this catalogue is to present the auroral activity in a manner which can be used by others in the interpretation of aurorally associated phenomena. From the general appearance of the spectra and other factors, a table of daily index numbers (1-9) is given for two observing periods. Although these numbers should not be used in themselves as correlation data they are valuable as representative indices. This point is indicated by the clear appearance of the spring maximum in activity and a general yearly decline in activity towards the minimum of the sunspot cycle.

Introduction

The Geophysical Institute of the University of Alaska, because of its ideal location in the northern auroral region, has been a center for research on the aurora borealis and other upper atmospheric phenomena for many years. Because of the great activity in this field the need for some type of auroral index has been recognized here for a long time. With the advent of the International Geophysical Year and the greatly expanded research in upper atmospheric physics, the need for an auroral index increased. Perhaps the biggest problem involved in this matter is the inability of workers in the field to decide what type of index would best represent the auroral activity.

The Geophysical Institute has operated a prism dispersion (Huet) spectrograph in a routine program for the last four years. This instrument subtends a field of 11° and records the time-resolved spectra from the magnetic zenith at College, Alaska by the use of a moving plate holder. The effective exposure, determined by the slit length and speed of motion of the plate holder, is approximately one hour. The operation of the instrument is routine, and the data obtained in approximately one square centimeter of the photographic plate represents the time variation of the auroral emissions throughout the night. For general correlations in the field of upper atmospheric physics these compact low-time-resolution spectra have been used as a general index of the auroral activity. From this use the present catalogue has evolved. The following report is a

compilation of all Huet spectrograms from the fall of 1957 through the spring of 1959. It is the author's hope that others will be able to use these spectra as a basis for preliminary correlations which could then lead into more detailed studies.

Catalogue Format

The catalogue format was designed to present the spectra in as concise a manner as possible. Since showing the detailed intensity and time variations of all the individual lines was not the prime purpose, it was felt that the size of the spectra should be governed only by the ability of the reader to obtain a general idea of the time variation of the intensity throughout the night. However, the final decision concerning the size of the spectra was based on the thought that a large number of spectra lined up consecutively would provide the best opportunity to see any gross trends or fluctuating cycles in the activity.

One of the easiest grouping systems is a division into calendar months. Since this satisfies all of the requirements, it is the system which has been used. Thus the catalogue consists of the spectra grouped monthly with each month taking up an individual page.

Because of the small size of the spectra in this format some system for identifying the different wavelengths in the auroral spectrum was needed. The small size and multitude of spectra did not permit individual wavelength scales on each spectrum. Consequently it was decided to include a master

spectrum with all of the major auroral emissions identified. The master is in the form of a fold out sheet at the end of the catalogue and is readily available for comparison with the smaller spectra. To orient those unfamiliar with spectra, a circle is drawn above the auroral emission line at 5577A on both the small spectra and the master spectrum. With this as a reference mark, it should be relatively simple to find, on the small catalogue spectra any emission line which is on the master.

The time scale is based on 150° West Meridian time with 00 indicating midnight between the two dates listed at the right side of each spectrum. The time varies from evening twilight at the bottom of each spectrum to morning twilight at the top. The time marks are at two-hour intervals, and no greater than one-hour accuracy should be used.

On many nights uniform moonlight contamination fogs most of the spectrum (Jan. 4/5, 1958). However if the aurora was of nominal intensity at least the 3914A band of N_2^+-1st negative system should be visible (Mar. 4/5, 1958). When the aurora is very bright each emission line will appear as a sharp image of the slit. The narrow band on Mar. 12/13, 1958 at 00 is an example. The continuous light contamination observed as discrete streaks across the spectrum (Dec. 10/11, 1957) is due to moonlight on scattered clouds.

The parameter used to determine the degree of cloudiness is the intensity of the mercury emission lines on the spectra.

The physical location of the spectrograph is 1-1/2 miles from the mercury vapor street lights on the campus of the University of Alaska. Thus the degree of cloudiness or overcast determines how much scattered mercury light enters the spectrograph. Even on perfectly clear nights some scattering takes place, and consequently some mercury emission is visible on the spectrum. The master spectrum illustrates the intensity of the mercury lines on a clear night; any weaker intensity is of course also indicative of a clear night. The strong mercury intensity on Oct. 18/19, 1958 illustrates a complete overcast.

Activity Index

Table 1 has been compiled to facilitate the use of the catalogue. This table essentially summarizes the data. The numbers in the table indicate qualitatively the author's interpretation of the degree of activity and are intended basically as an aid to those unfamiliar with spectra. The values range from 1 through 9, where 1 indicates no aurora at the College zenith all night. The number was obtained by qualitatively weighing the general intensity, the number of hours over which the display lasted, the occurrence of the auroral emissions with respect to midnight, and the type of display determined by the relative intensities of different emission features. Their primary purpose should be to ascertain whether or not it would be advantageous to look at a particular spectrum to see if any correlation at a definite time exists

with other data. They are not intended primarily to be used as numbers to correlate with other data. However, as a representative index they are not too inconsistent. The row labeled Normalized Sum in Table 1 clearly shows the spring maxima in the activity and the general decrease in yearly activity towards the minimum of the sunspot cycle. Also the variation in the numbers for any particular month follow fairly well the variations in the magnetic activity. This correlation is exemplified in Fig. 1, using Jan. 1958 data and the 3 hourly College K-indices summed over the hours during which the spectra were obtained. The match between the character of the two curves is quite good, considering the ambiguity in the meaning of the K-Index sum. In other spectroscopic work (Rees, Belon, Romick, Plan. & Space Sc. 1961, in press) a better correlation has been found between magnetic activity in gammas and the southern motion of the hydrogen arc and, consequently, the southern motion of the aurora in general. Thus although the daily index numbers listed in Table 1 perhaps do not provide all of the information that might be desired, they should enable any experimentalist to determine if there is any correlation trend between his data and auroral activity which would warrant a more extensive study of the individual spectra.

TABLE 1

ACTIVITY INDEX

Date	1957 Sept	Oct	Nov	Dec	1958 Jan	Feb	Mar	Apr	Aug	1958 Sept	Oct	Nov	Dec	1959 Jan	Feb	Mar	Apr
1-2		4	1	5	5	3	4	5		3		3		3	6	5	3
2-3		4	3	5	4	4	4	5		4		4		3	3	5	4
3-4		4	6	4	3	4	5	6		3	3	3		3	4	5	3
4-5		4	1	6	3	4	5	6		4	3	1		3	4	4	1
5-6		3	1	6	4	6	5	6		3	3	1	6	4	3		1
6-7		3	4	5	3	5	5	7		4	4	3	5	4	3		3
7-8			5	5	5	4	4	4		3	2	3	4	4			4
8-9		4	6		4		6	4			3	1	5	5			4
9-10		6	6	5	4		5	2	4	3	1	3	1	7		3	5
10-11		6	5	4	3	9	4	2	5	3	1	4	2	4		2	4
11-12		5	4	5	5	6	6	2	5	1	1		2	3		4	4
12-13		6	4	5		6	6	3	5	1			5	4		4	3
13-14		7	4		5	7	5	4	1	1	3		4	3	4	4	2
14-15		5	4	6	6	4	5	6	3	1	4		3	4		3	1
15-16		3	5	4	5	5	2	7	3	3	4	4	4	4		2	3
16-17	5	4	3	5	6	6	6	7	5	3	1	4	4	5	5	1	3
17-18	1	1	7	5	7	6	7		4	1	3	4	2		1	1	1
18-19	3	3	4	5	5	5	7		3	3	3	3	5		4	2	3
19-20	3	3	3	5	6	6	6		1	2	1	3	3		1	3	3
20-21	6		2	6	6	8	7		3	2	3	3	3		2	3	4
21-22		3	3	2	6	7	5		4	2	6	3	3		3	1	1
22-23		4	4	2	7	7	7		4	2	7	4			4	3	
23-24	6	3	5	3	4	5	7	6		3	5	4			3	3	4
24-25	5	3	7	4	5	4	8	6		5	1	3		4	5	4	5
25-26	5	3	7	6	5	3	6	2	5	5	3	4		4	5	4	4
26-27		5	8		2	3	6	2	5	5	3	4	4	3	4	7	5
27-28	2	5	8	1	4	5	5	5	3	4	4	4	3	3	5	7	6
28-29	8	6	7	3	5	3	4	5	3	3	4	5	1	4	5	7	6
29-30		6	4	5	3		7		3		5	3	3	4		6	6
30-31		4	7	7	3		5		3		4	1	2	5		6	6
31-1		3		6	4		6		3		3		1	5		4	
Normalized sum	4.4	4.1	4.6	4.6	4.6	5.2	5.5	4.6	3.6	2.9	3.1	3.2	3.3	4.0	3.7	3.8	3.5
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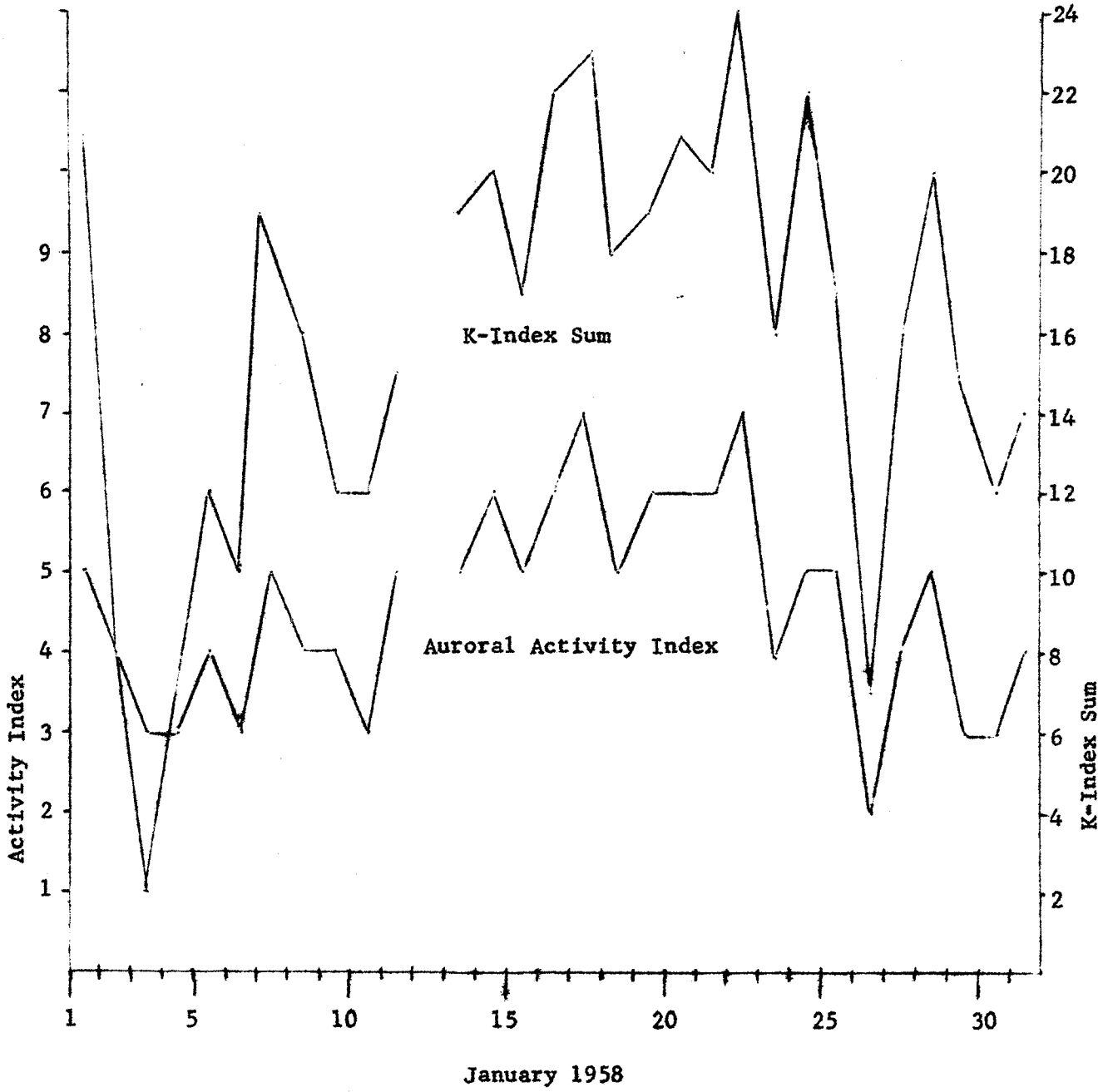
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Activity Index
K-Index Sum
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Figure 1

Conclusion

Although the time resolution on the individual spectra is only one hour, some information on the simultaneity of occurrence of auroral activity on a global basis should be obtainable by comparing the College, Alaska data with that obtained at other stations throughout the world. In particular, the general comparison between the auroral activity at College, which is in the northern hemisphere, and that at different stations in the southern hemisphere should indicate the possibility of simultaneous activity in the two hemispheres. The data in this catalogue covers the auroral observing seasons contained in the International Geophysical Year and the International Geophysical Cooperation. It is anticipated that this information will be helpful in the interpretation of other data, obtained during the same period, which might be aurorally associated, and it is hoped that the information will thus help to clarify and increase our knowledge of the upper atmosphere.

Acknowledgements

The data presented in this report was obtained under Navy Contract Nonr-1289. The author is indebted to his colleagues at the Geophysical Institute for their interest and helpful discussions concerning the presentation of this material.

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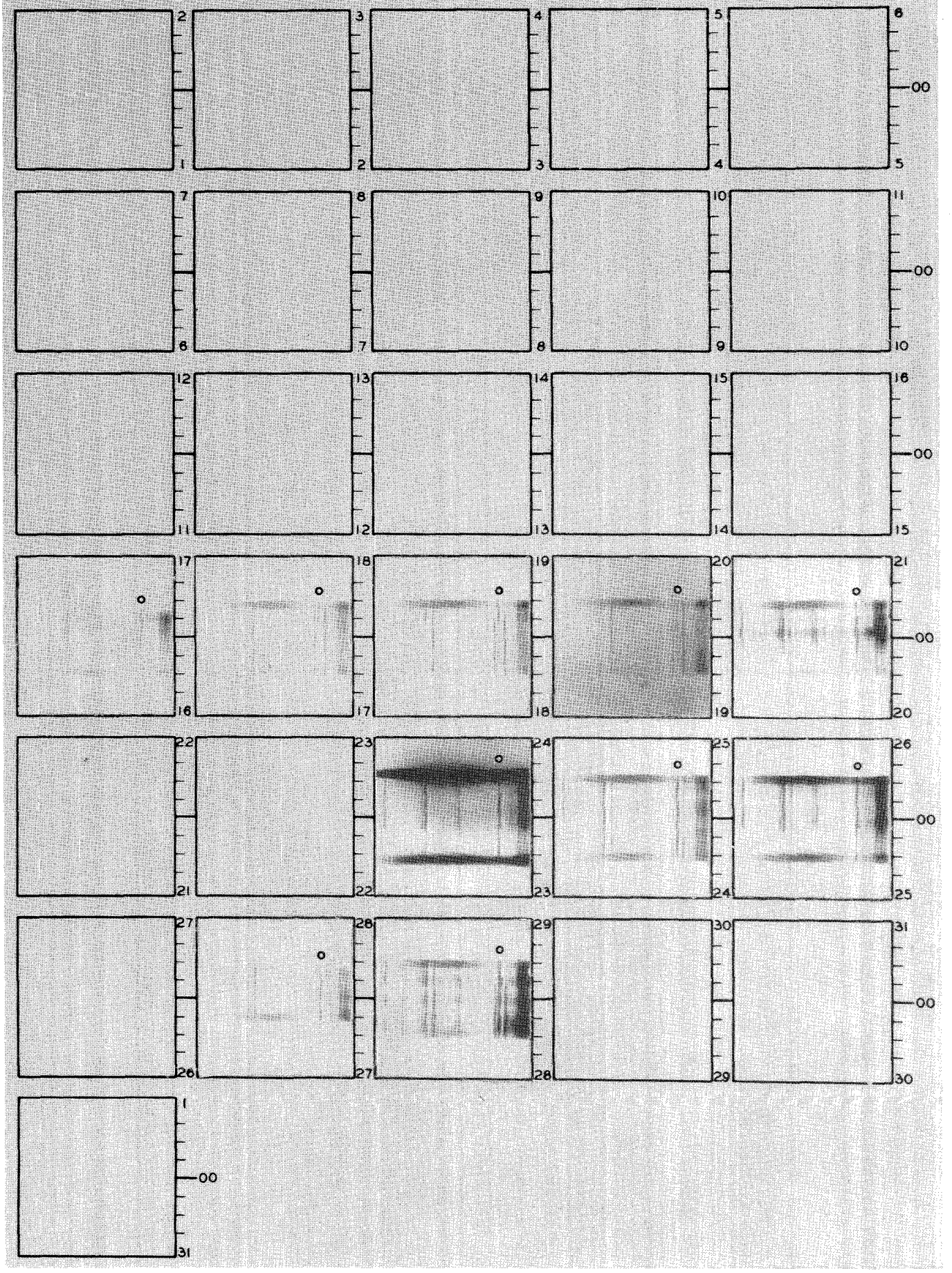

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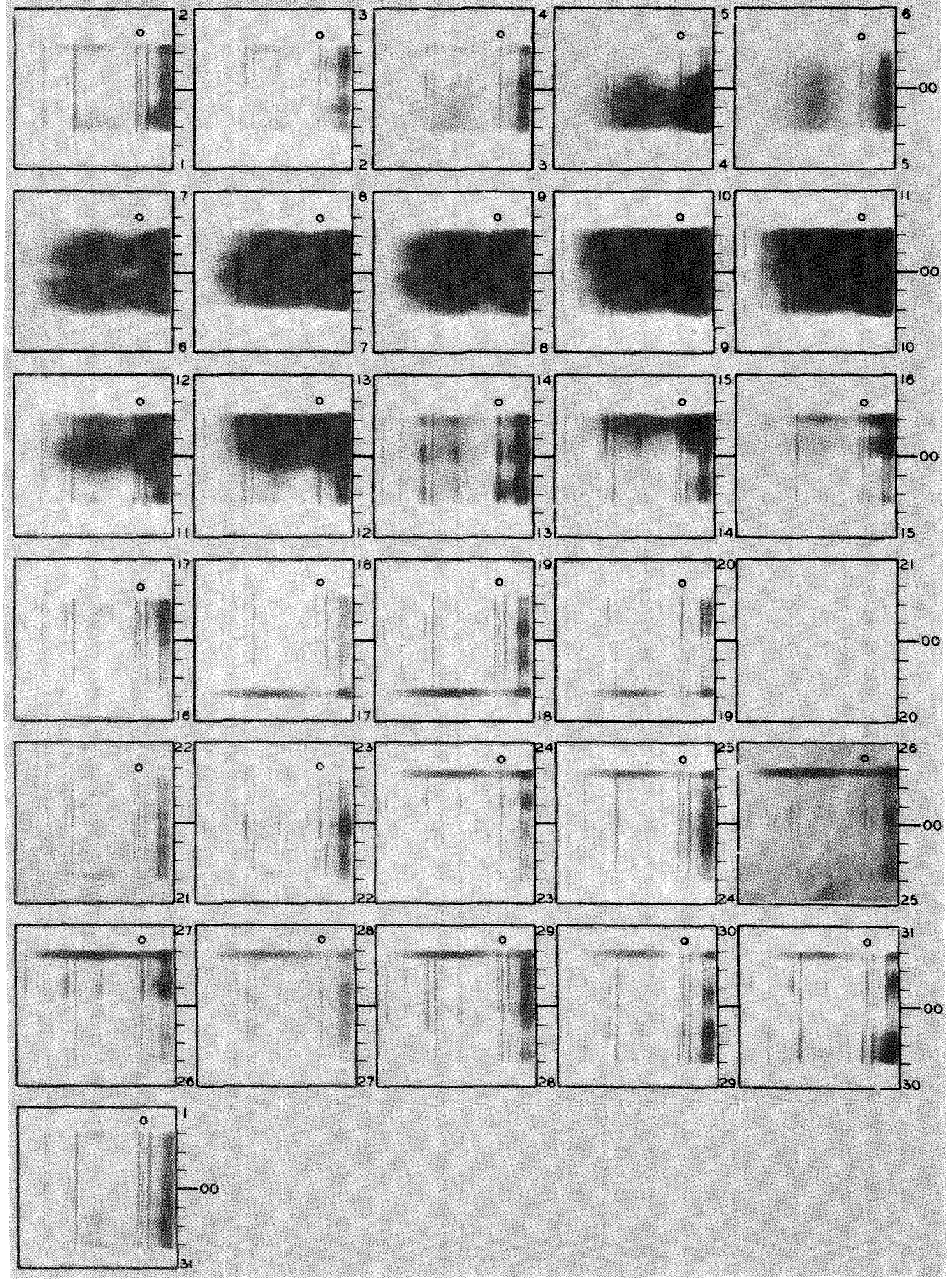

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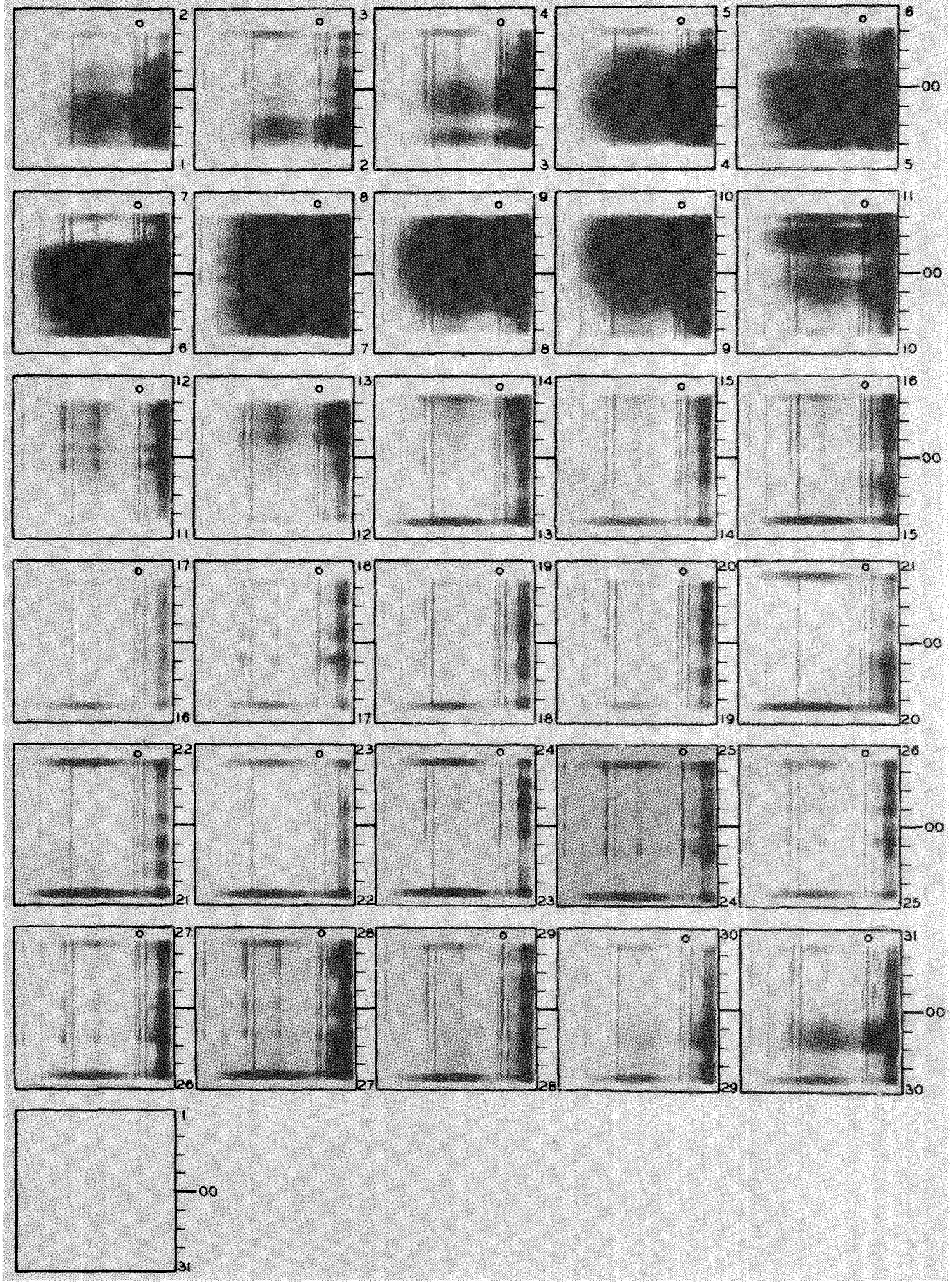

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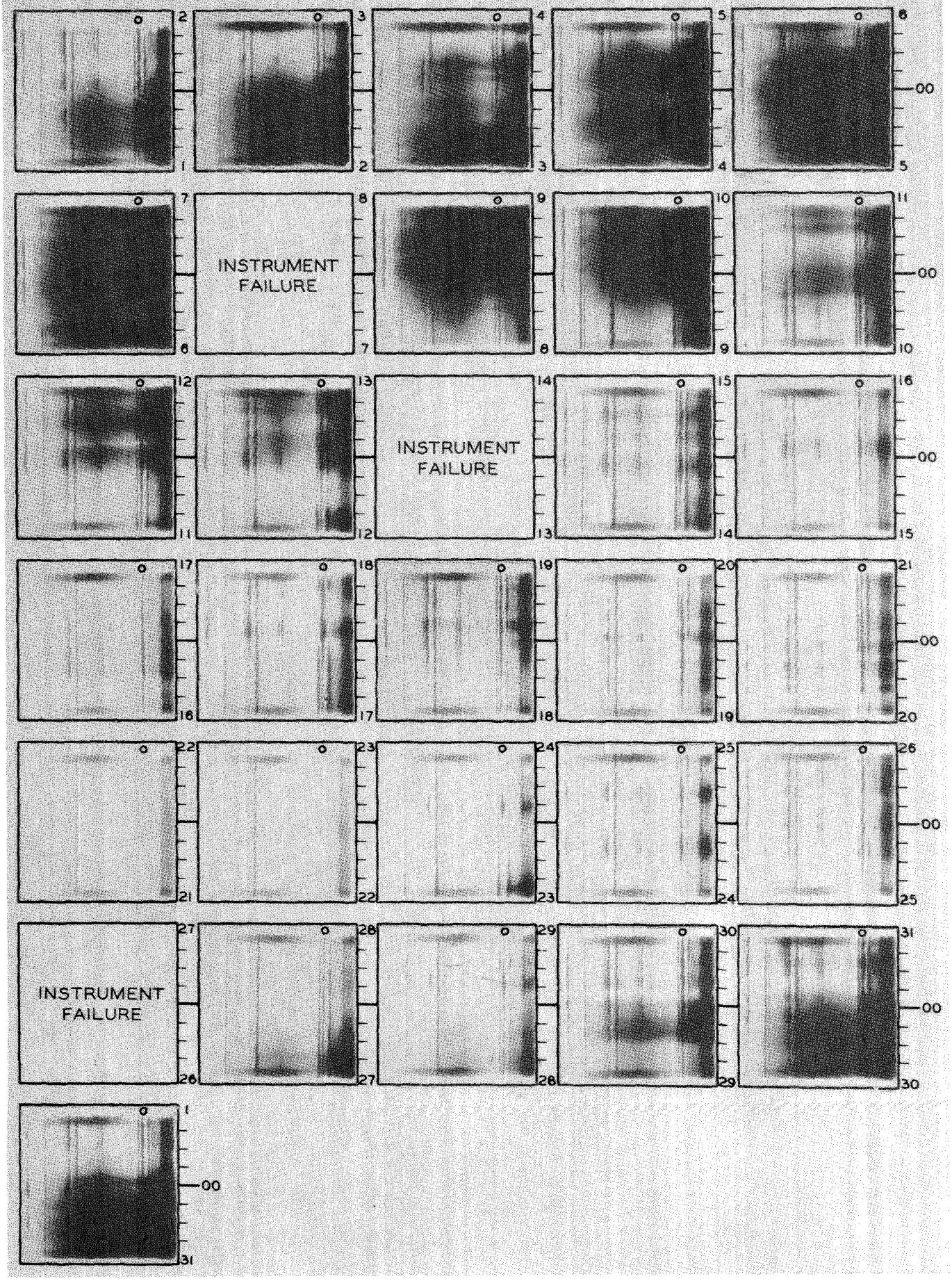

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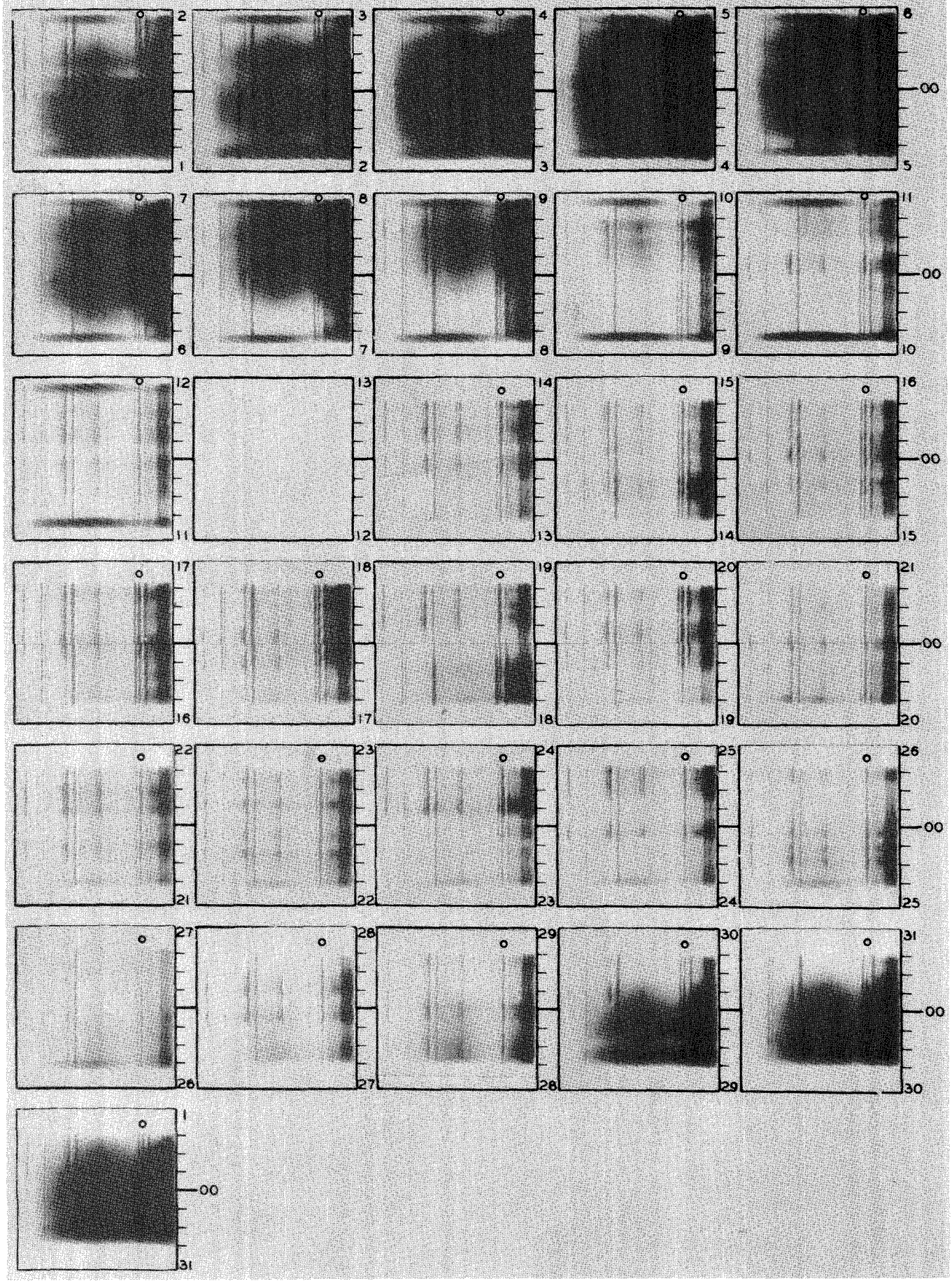

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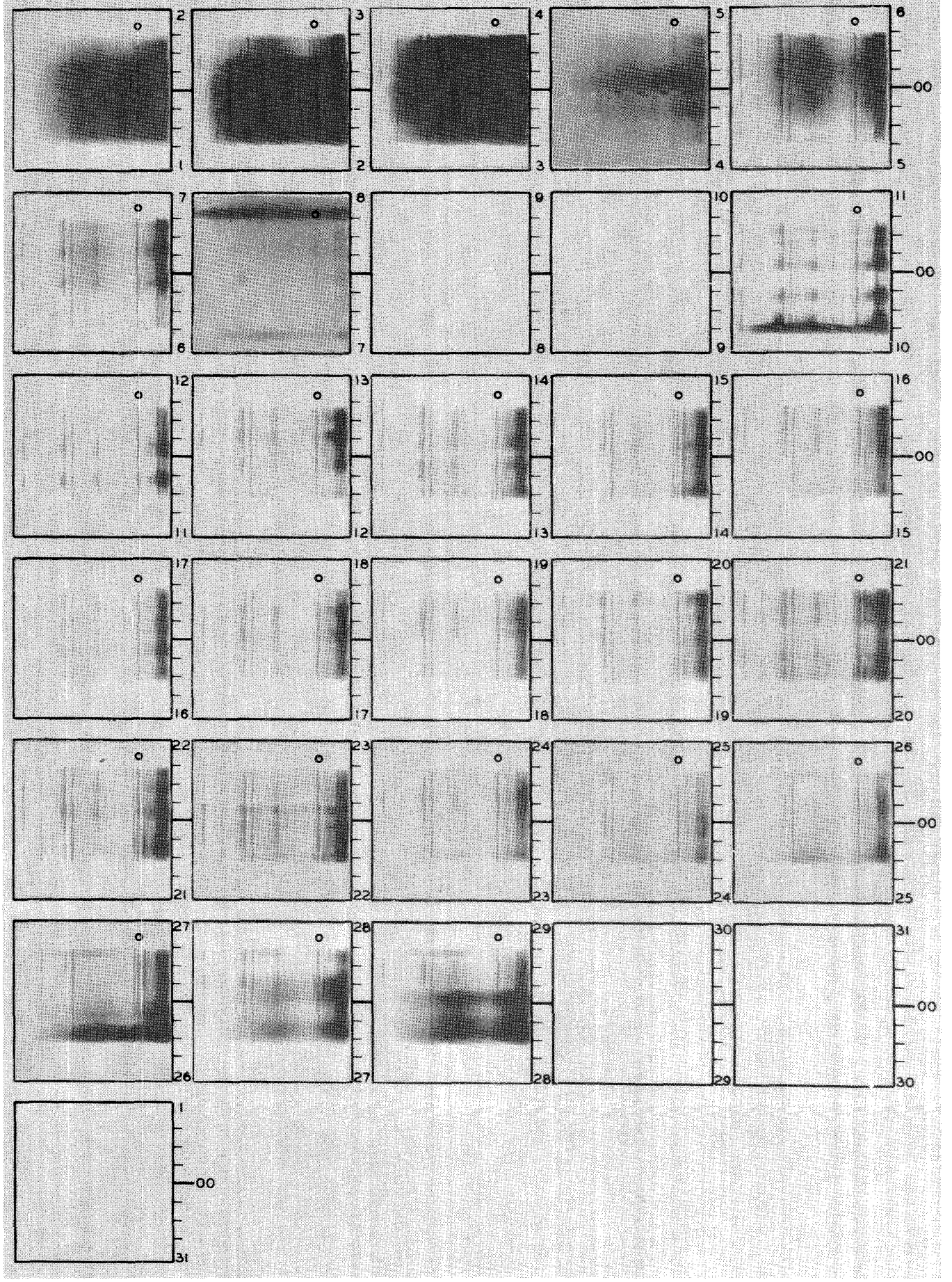

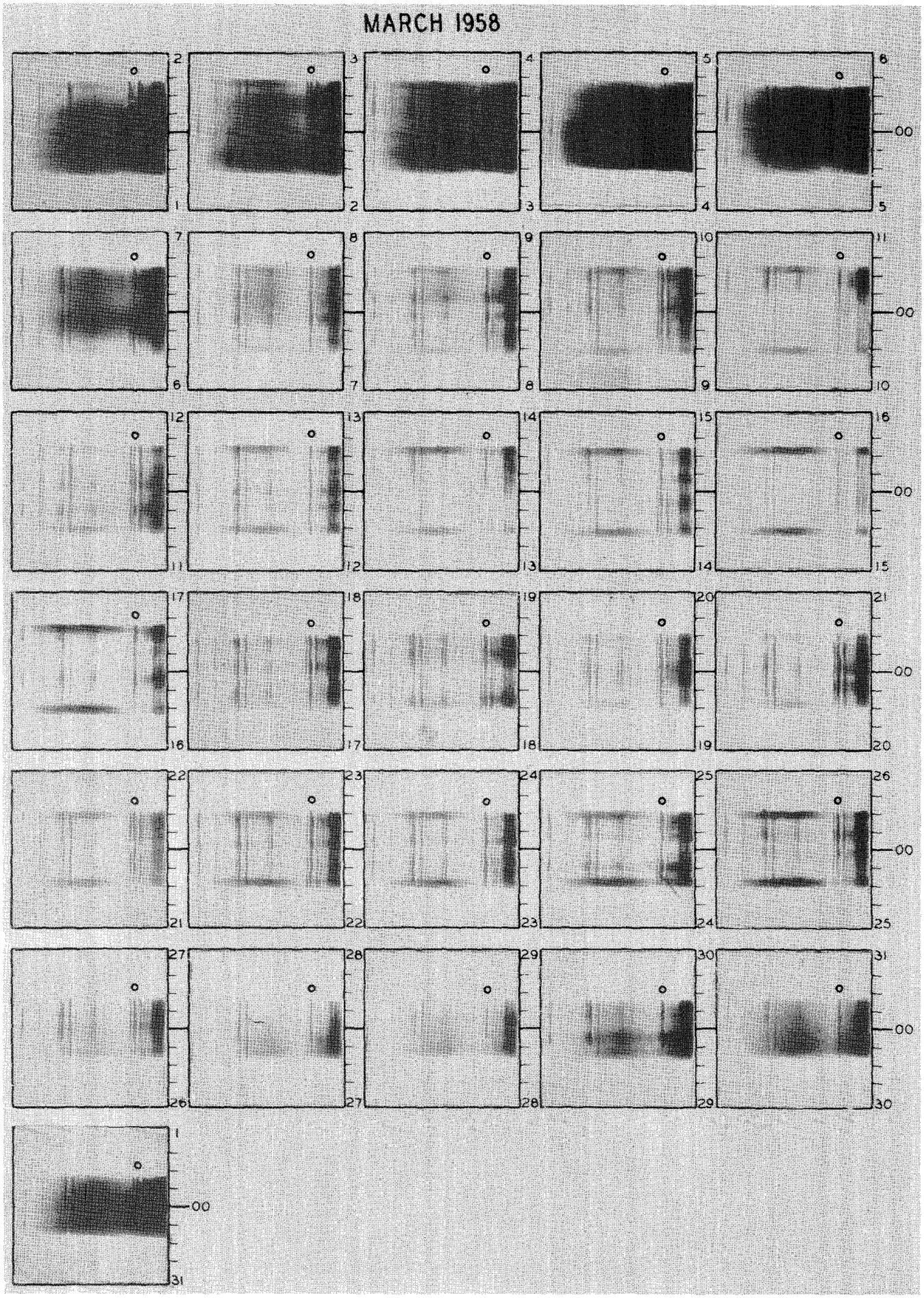
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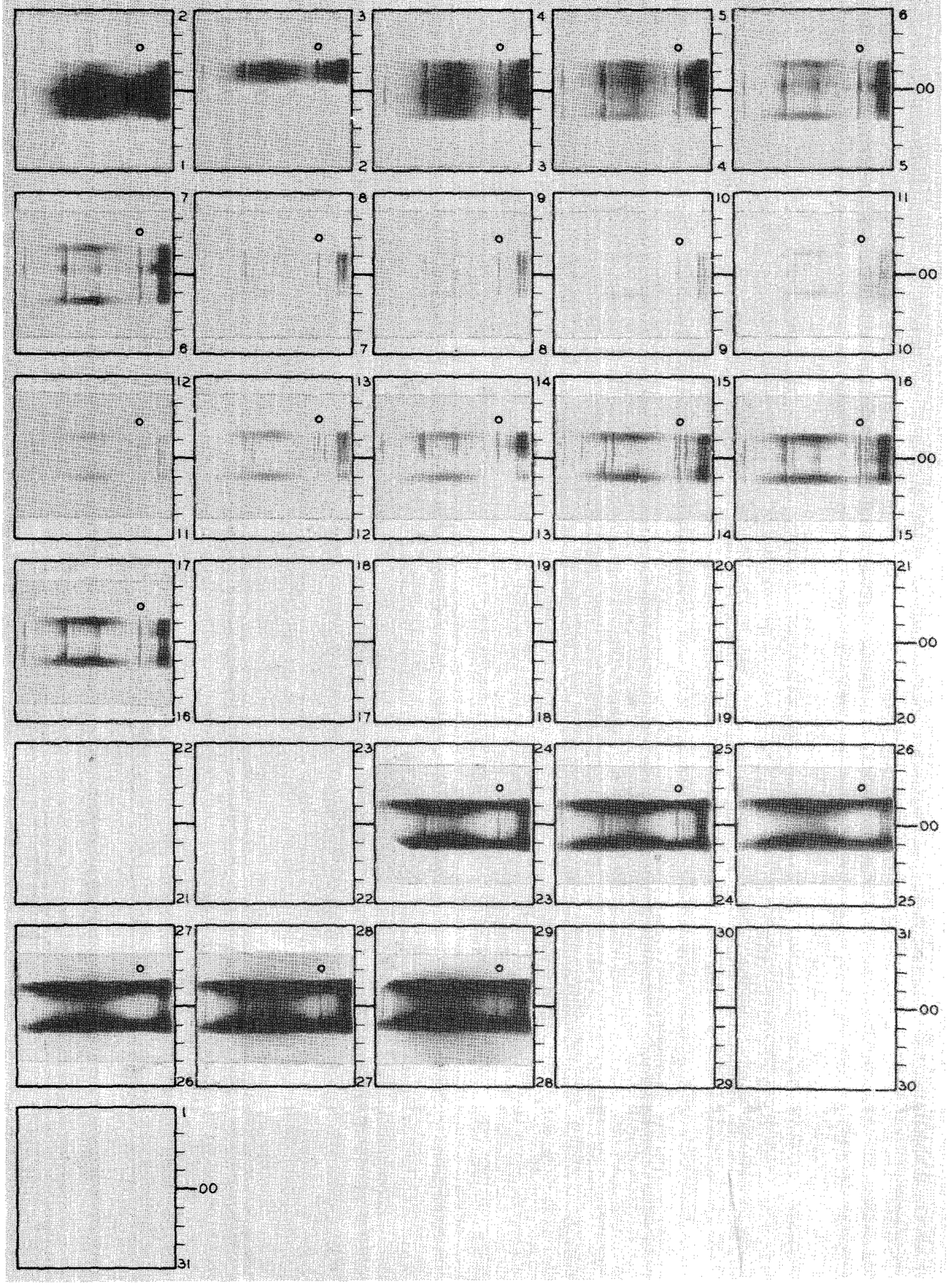
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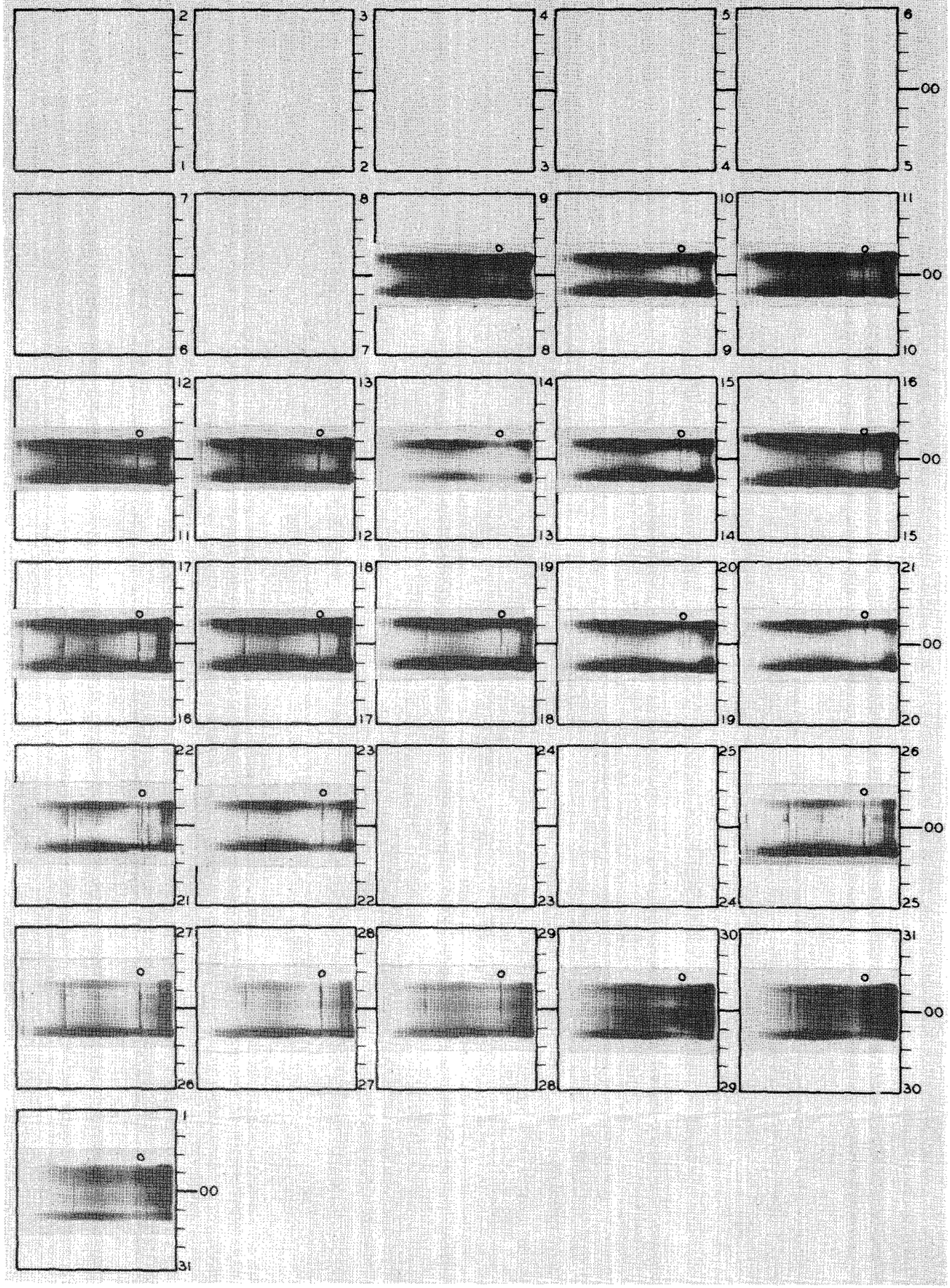
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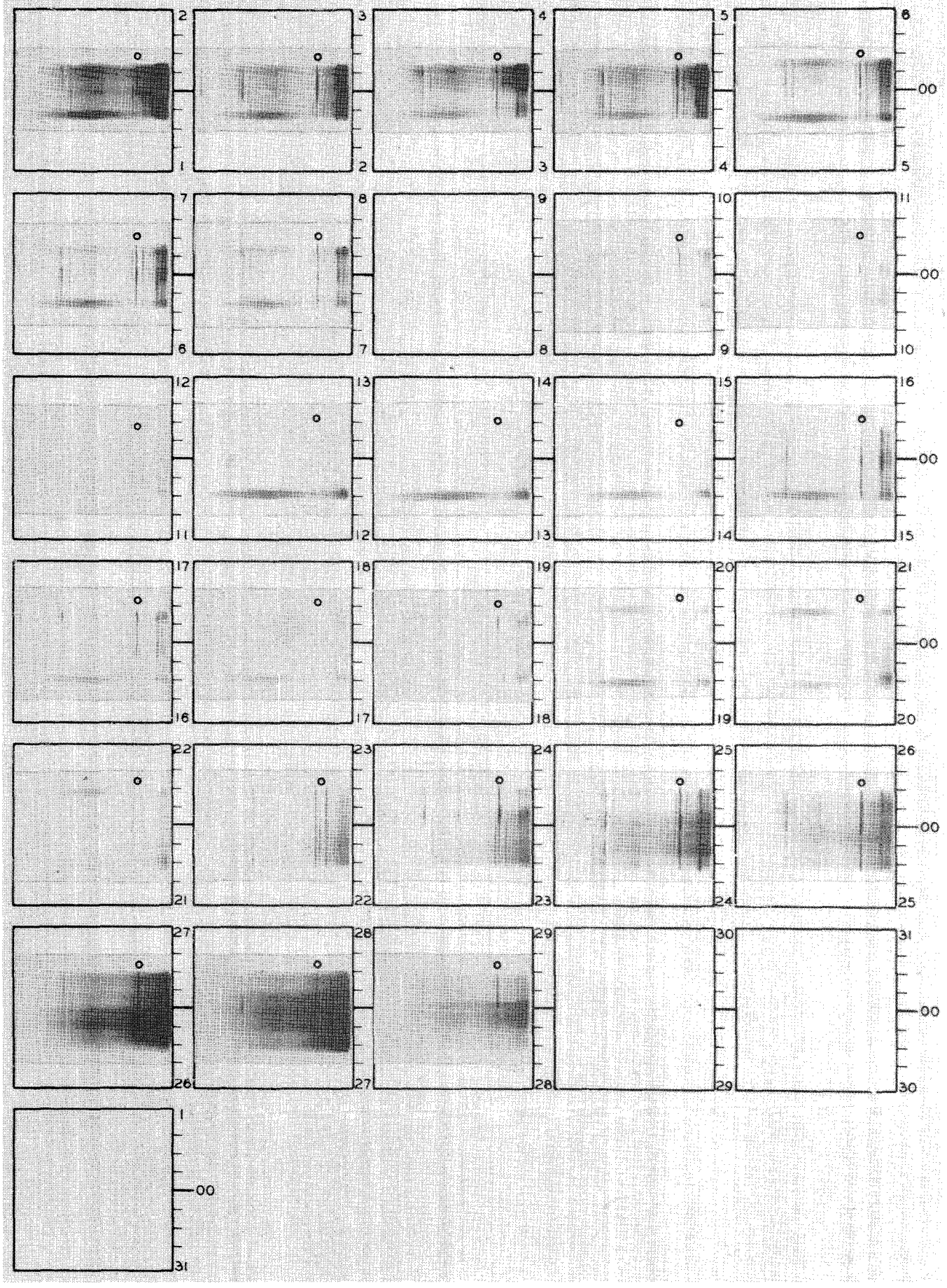

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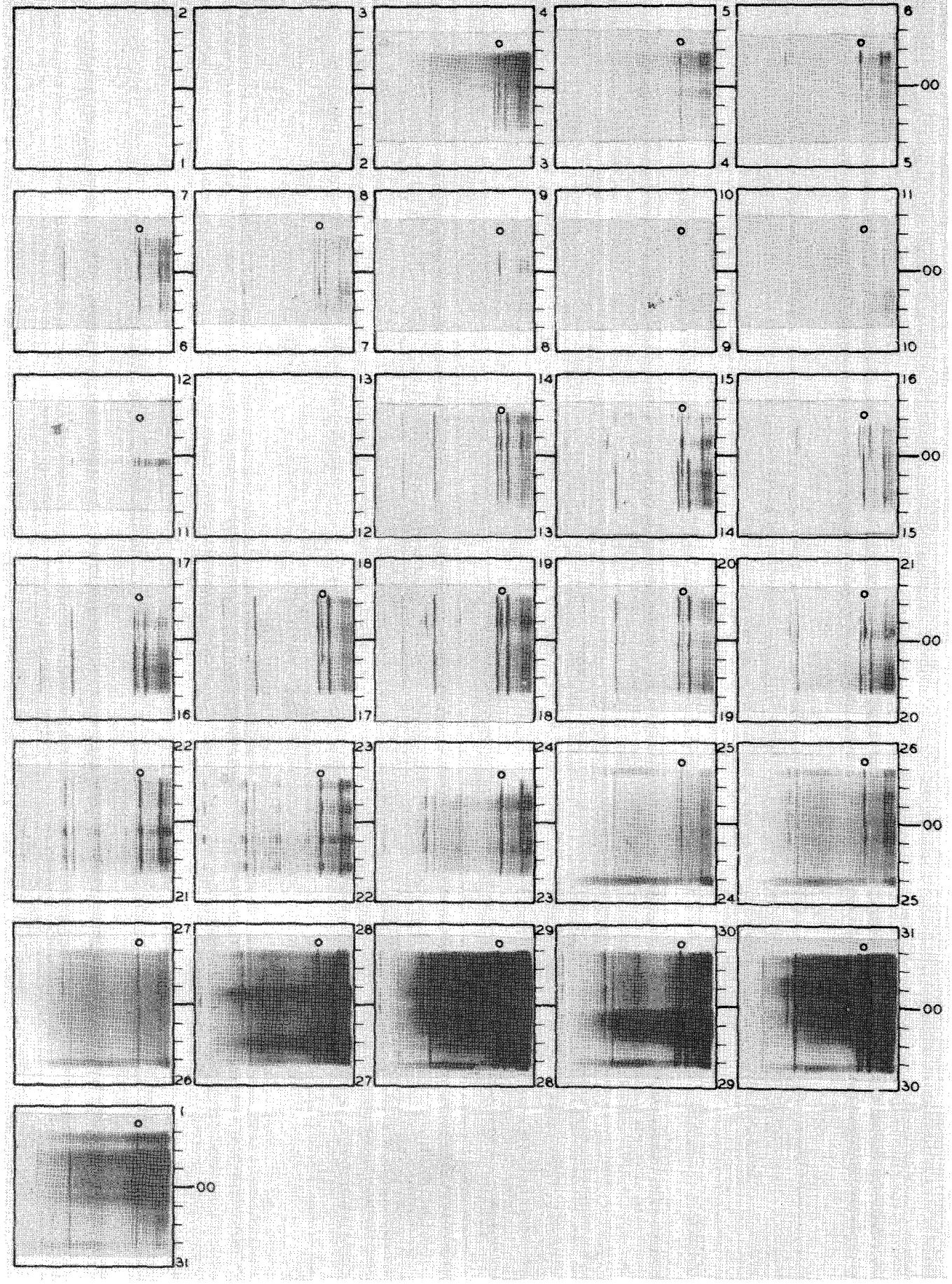

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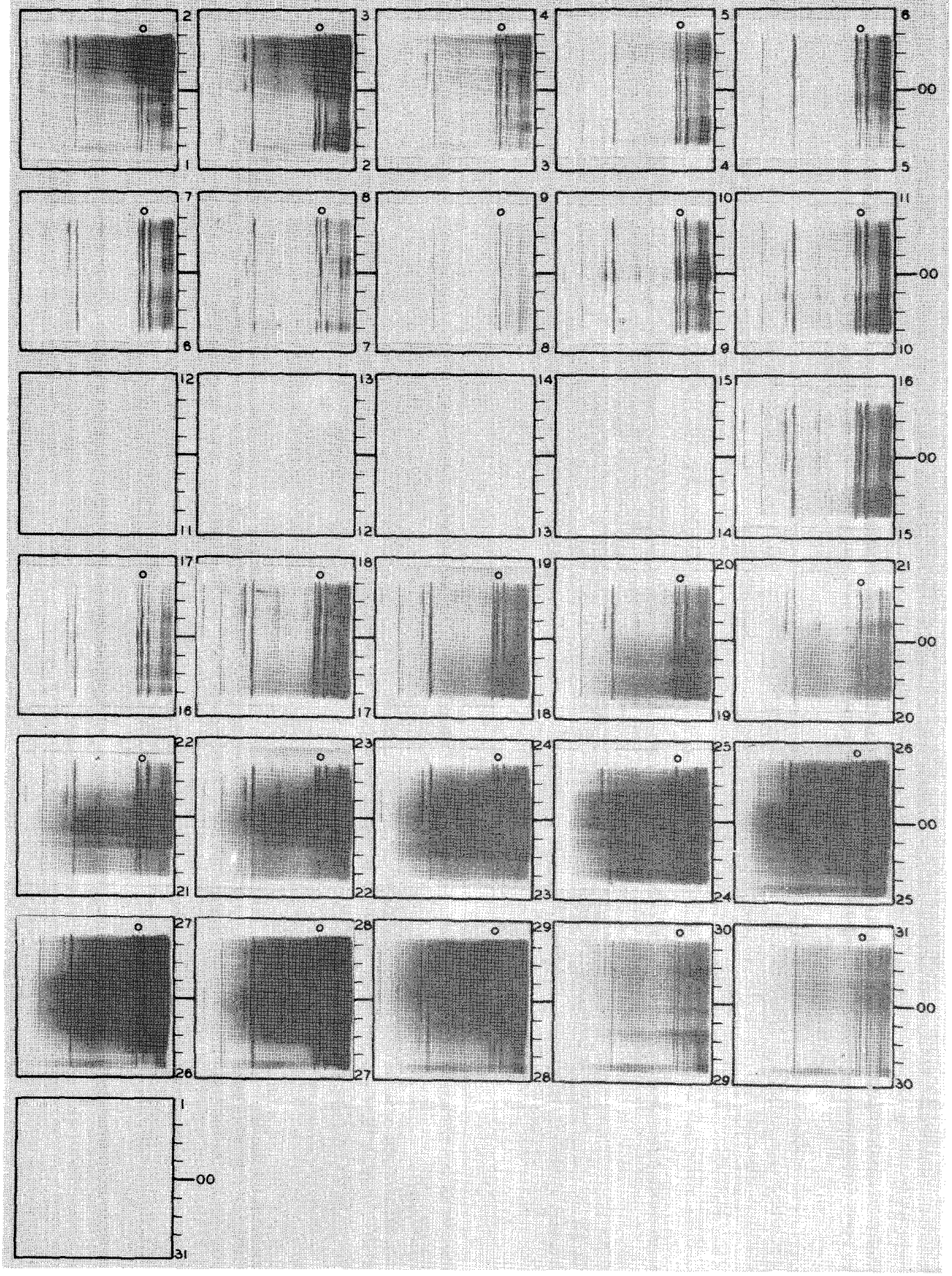

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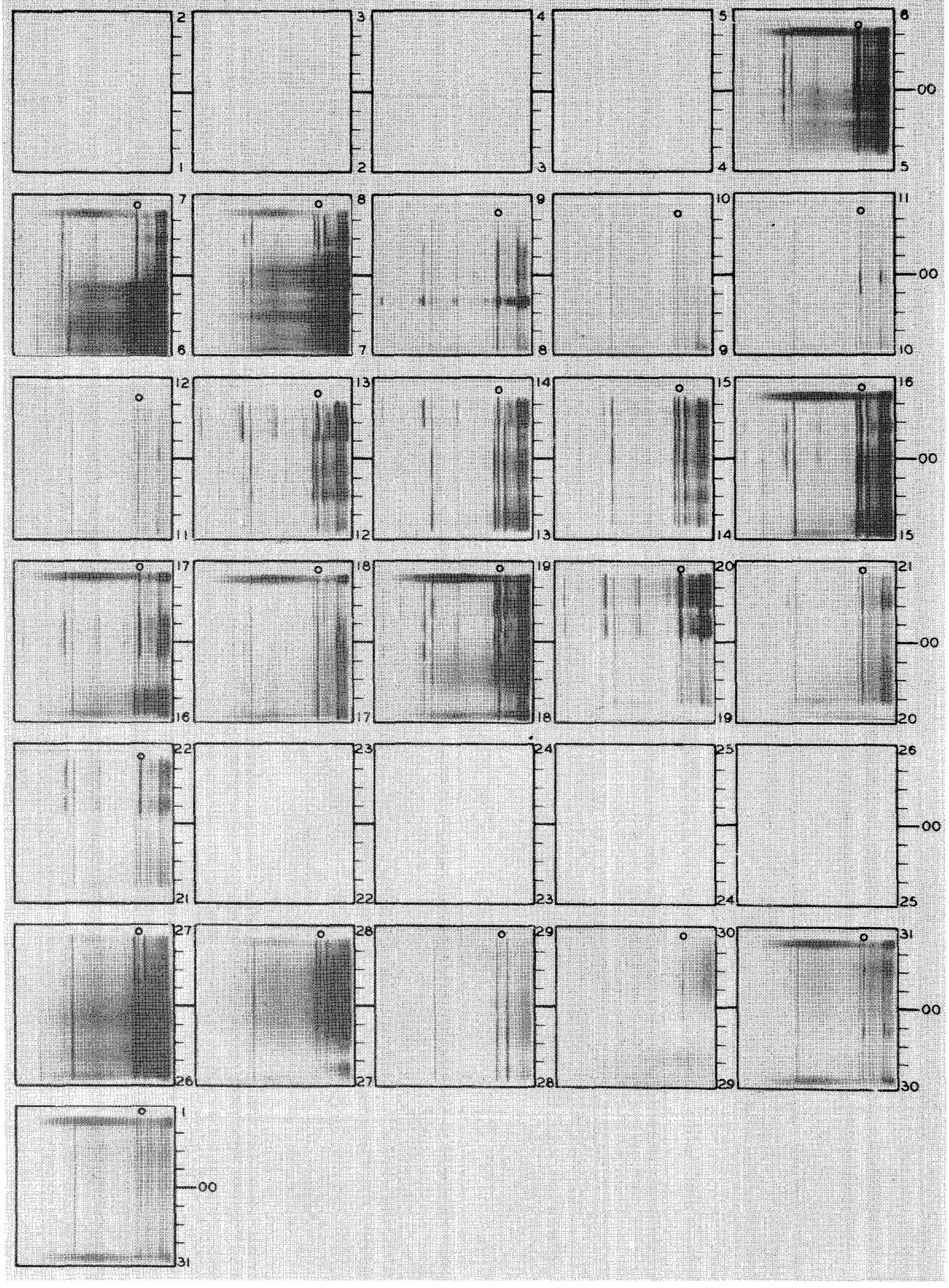

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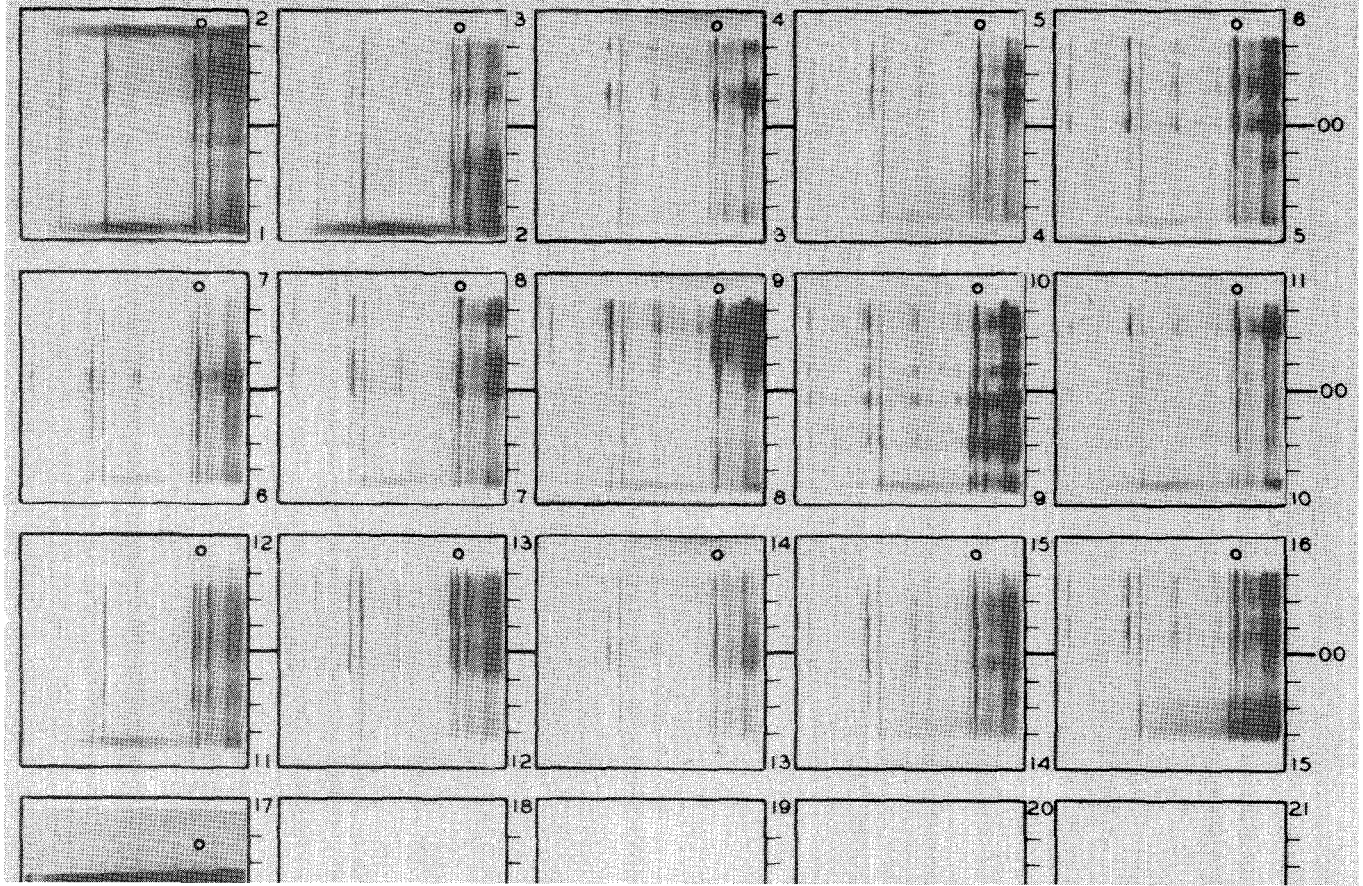

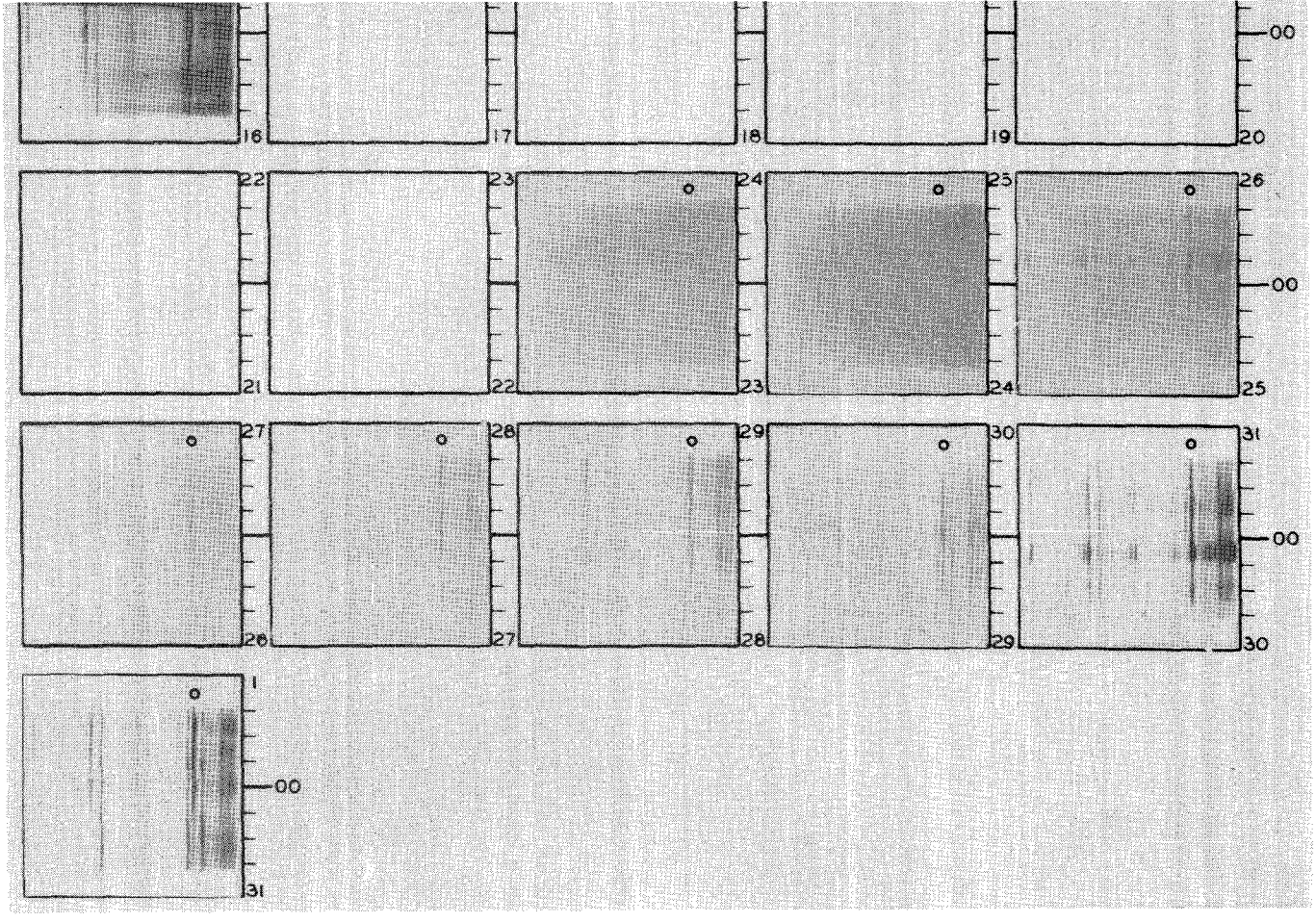
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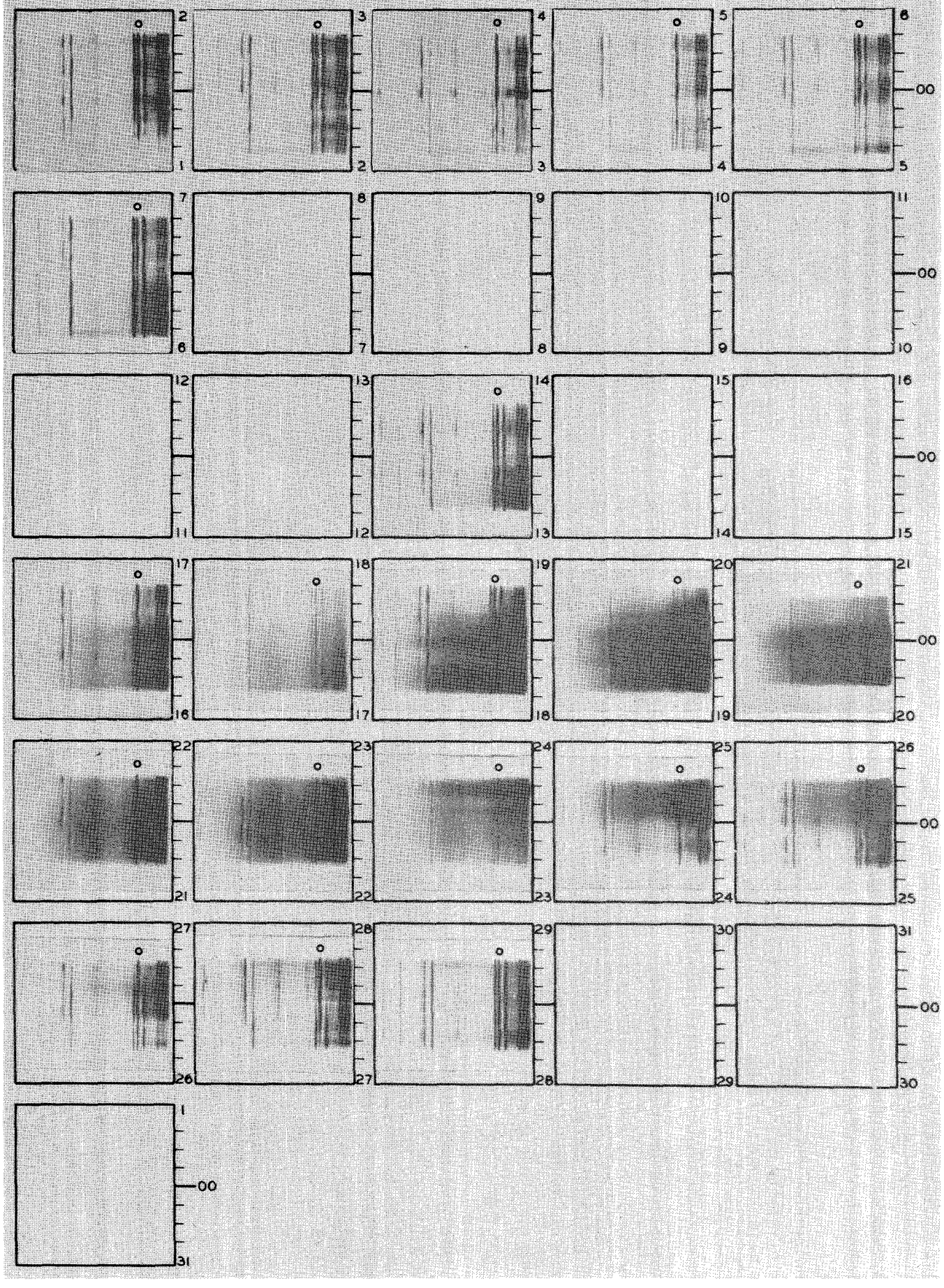

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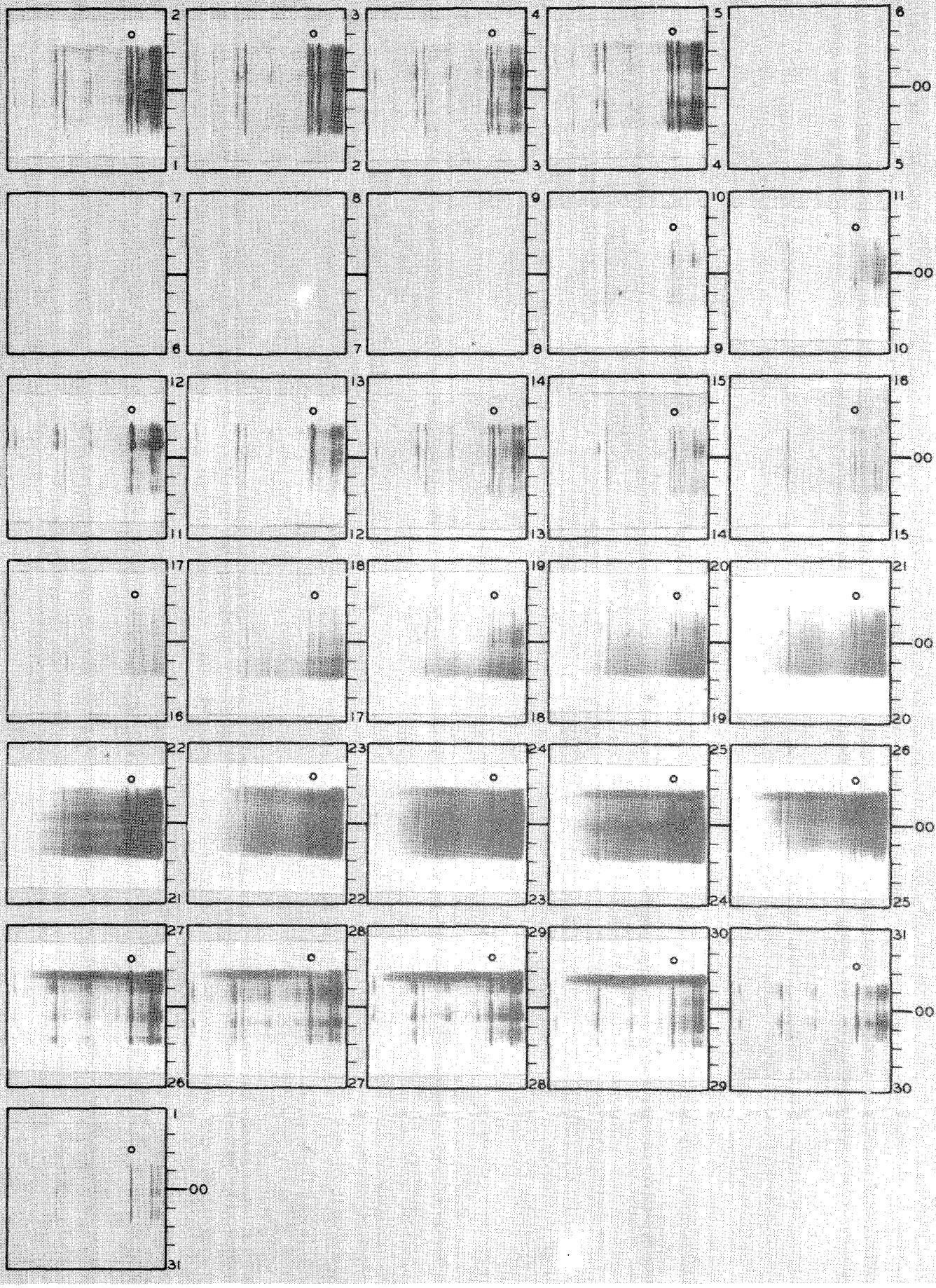
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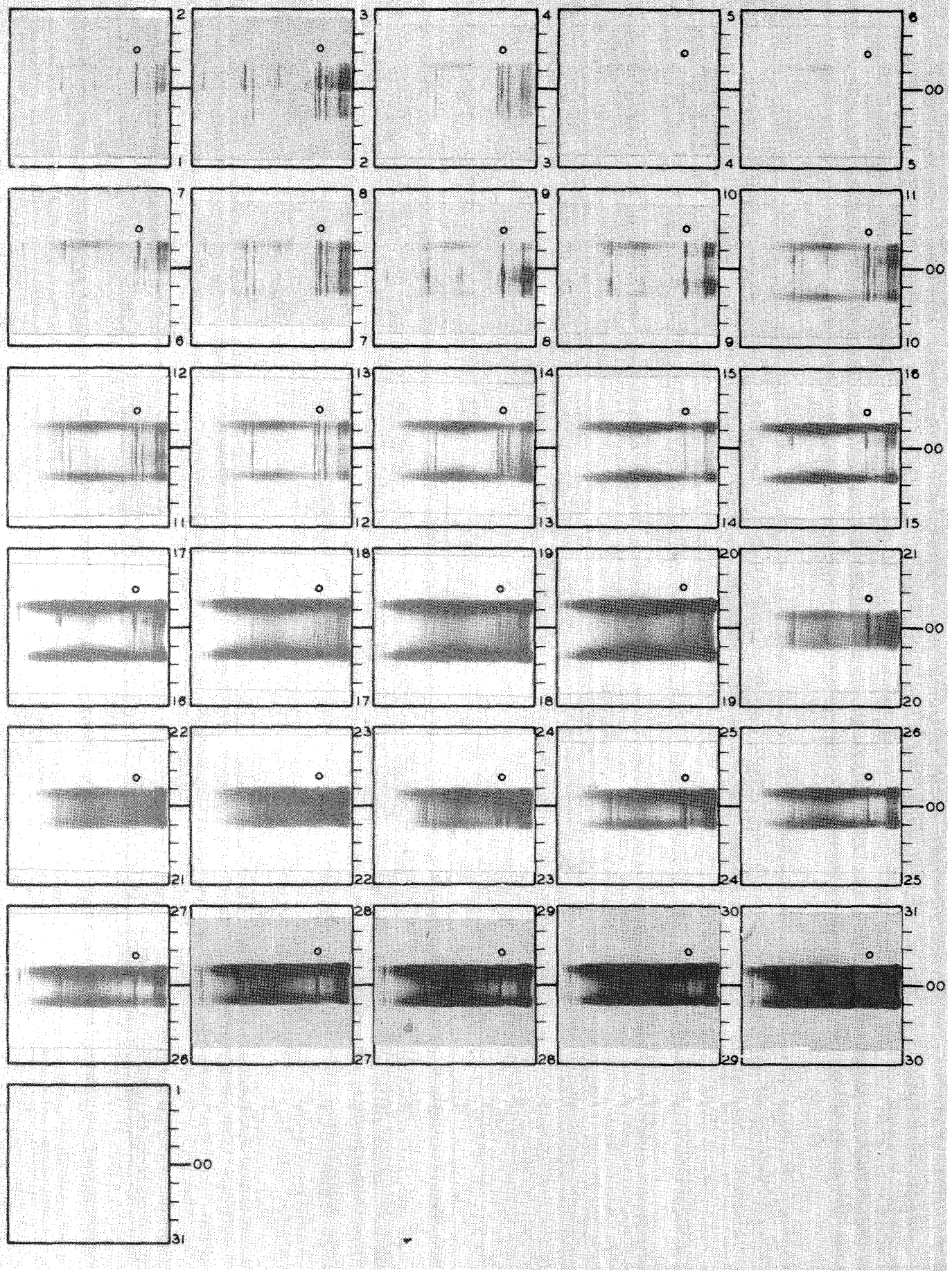
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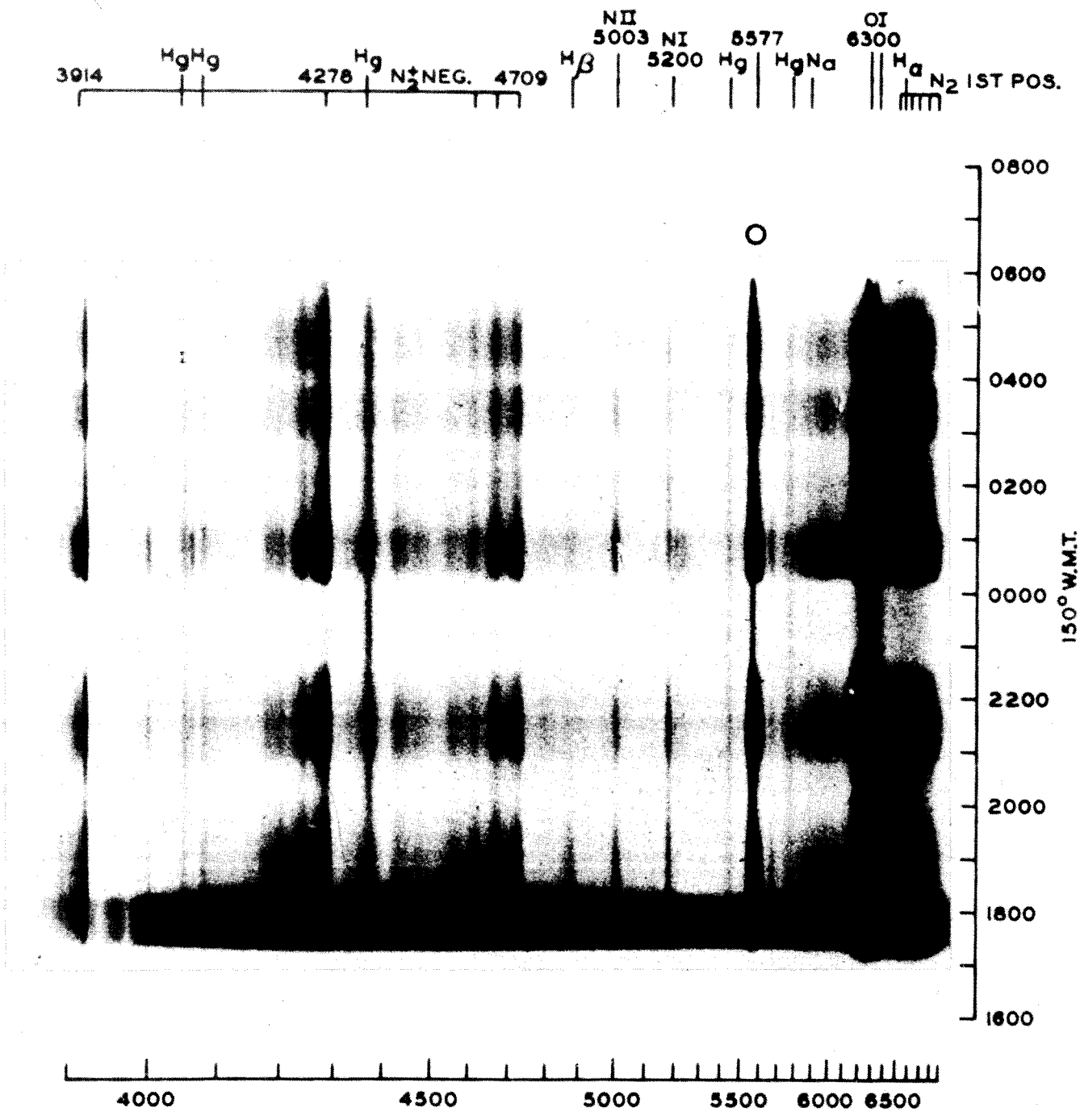
HUET SPECTROGRAPH PLATE
ZENITH SPECTRA
COLLEGE ALASKA



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Bureau of Naval Weapons
Attn: FAME-3
Department of the Navy
Washington 25, D.C. 1

U.S. Navy Electronics Laboratory
Meteorology Section
San Diego 52, California 1

U.S. Naval Ordnance Laboratory
White Oak, Silver Srring, Maryland
Attn: Librarian 1

Bureau of Ships
Department of the Navy
Washington 25, D.C.
Attn: Special Devices Center 1
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Director, Office of the U.S. Naval Weather Service
U.S. Naval Station
Washington 25, D.C. 1

Superintendent
U.S. Naval Postgraduate School
Monterey, California
Attn: Officer in Charge, Project NANWEP 1

Office of the Chief Signal Officer
Department of the Army
Attn: SIGRD-4c
Washington 25, D.C. 1

Wright Air Development Div.
(WWRNRE-2, Mr. D. R. Sink)
Wright-Patterson AFB, Ohio 1

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Air Force Research Division
Geophysics Research Directorate (CRZWR)
L. G. Hanscom Field
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Commanding General
Air Research and Development Command
Attn; RDG
Andrews Air Force Base
Washington 25, D.C. 1

Pacific Missile Range
Code 3101-1.1
Pt Mugu, California
Attn: Commanding Officer 1

U.S. Army Signal Missile Support
White Sands Missile Range, New Mexico
Attn: SIGWS-MG 1

APGC (PGTRI, Tech. Lib)
Eglin AFB, Florida 1

Detachment No. 11
4th Weather Group
Patrick Air Force Base, Florida 1

Detachment No. 24
4th Weather Group
AFMDC, Holloman Air Force Base
New Mexico 1

U.S. Army Electronic Proving Ground
Meteorology Department
Ft. Huachura, Arizona 1

Detachment No. 10
4th Weather Group
Eglin Air Force Base, Florida 1

National Aeronautics and Space Administration
Langley Research Center,
Langley Field, Virginia
Attn: Librarian 3

Headquarters, 4th Weather Group Andrews Air Force Base Washington 25, D.C.	2
Pan AmericanWorld Airways, Inc. MU 127 Patrick Air Force Base, Florida	1
Meteorological Division R.O. Department Pacific Missile Range Pt. Mugu, California	1
2 Weather Wing Attn: Technical Services APO 633, New York, New York	1
3 Weather Wing Attn: Technical Services Offutt Air Force Base Nebraska	1
5 Weather Group Attn: Technical Services Westover Air Force Base Massachusetts	1
2 Weather Group Attn: Technical Services Langley Air Force Base, Virginia	2
28 Weather Squadron Attn: Technical Services APO 196 New York, New York	1
10 Weather Group Attn: Technical Services APO 925, San Francisco, California	1
1 Weather Wing Attn: Tecnical Services APO 915 San Francisco, California	1
4th Weather Wing Room 421, ost National Bank Bulding Colorado Springs, Colorado	2
9 Weather Group Attn: Technical Services Scott Air Force Base, Illinois	1

21 Weather Squadron
Attn: Technical Services
APO 283
New York, New York 1

31 Weather Squadron
Attn: Technical Services
APO 12
New York, New York 1

9 Weather Squadron
Attn: Technical Services
March Air Force Base, California 1

26 Weather Squadron
Attn: Technical Services
Barksdale Air Force Base, Louisiana 1

4 Weather Squadron
Attn: Technical Services
Hamilton Air Force Base, California 1

19 Weather Squadron
Attn: Technical Services
Richards-Gebaur Air Force Base, Missouri 1

8 Weather Group
Attn: Technical Services
Randolph Air Force Base, Texas 1

Experiment Section of the
Hawaiian Sugar Planters' Association
Attn: Librarian
Honolulu 14, Hawaii 1

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Shirely Highway and Edsall Rd.
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National Bureau of Standards
Boulder Laboratory
Boulder, Colorado 1

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